Pesticide Action Plan
CALFED Bay-Delta Program

Problem Statements:

Certain pesticides have been identified in surface waters of the Bay/Delta estuary and its watersheds at levels that are reported to impair aquatic life Beneficial Uses.

Current scientific knowledge is not adequate to determine the ecological significance or spatial and temporal extent of the impairments.

Justification. Pesticides, including diazinon and chlorpyrifos, have been identified by the CALFED Water Quality Technical Group (WQTG) in both the Central Valley and Delta as contaminants of concern. The chemicals were so designated because their concentrations in surface water exceed known toxic levels to sensitive organisms and chemical concentrations may alter the abundance and distribution of local species. The Sacramento and San Joaquin Rivers and the Delta-Estuary have been placed on the Central Valley Regional Water Quality Control Boards 303(d) list as impaired because of the presence of the two insecticides. Inability to prevent toxicity caused by these chemicals could impair CALFEDs ability to fully restore the ecological integrity of Central Valley Rivers and the Estuary.

Pesticide regulation is the responsibility of the Department of Pesticide Regulation (DPR) and the State and Regional Boards. The role of CALFED should be to use its prestige, expertise and resources in a coordinated effort with both the regulated and regulatory community to help develop a comprehensive pesticide monitoring program. When chemicals are detected in surface water at concentrations that impact beneficial uses, then CALFED should help develop and fund the scientific studies to evaluate ecological significance and the preferred management methods to control off-site movement. Pesticide regulation should be left to the regulator community.

General Approach CALFED proposes a two pronged pesticide action approach. First, a comprehensive bioassay and chemical monitoring program in the Central Valley and Estuary as a part of the CMARP (Comprehensive Monitoring and Research Program). Second, summarized in this document is what is known and what still must be ascertained for two insecticides (diazinon and chlorpyrifos) already identified in the system. This analysis is emphasized as it should serve as the template for the identification of other toxic pesticides and control of their toxic effects.

Impairment of Aquatic Toxicity
Surface waters in the Central Valley and Delta estuary have repeatedly tested toxic in bioassays. In some instances diazinon and chlorpyrifos have been identified as the principal cause of toxicity. In other cases, the chemical cause of toxicity was not identified. The CMARP Water Quality Section will perform monitoring using both US EPA standard bioassays and ecologically important local species to screen for and determine the temporal and spatial extent of toxicity. This monitoring should be coupled with chemical analysis and toxicity identification evaluation procedure to conclusively identify the chemicals causing toxicity. Once chemicals are identified, then follow-up studies should be undertaken to determine their concentration, duration and

frequency in surface water and also ascertain sources and fate. This information should be analyzed in a risk assessment fashion to help predict likely ecological significance of exceedances.

When chemicals are detected in surface water at concentrations which may impact beneficial uses then CALFED can help by facilitating the development of corrective actions. These actions should include development of water quality targets, development of management practices (MPs) to control off site movement, financial support to help implement the most cost effective of these, and monitoring to evaluate MP effectiveness once implemented.

Determining the source and extent of toxicity and corrective actions is sought in this section. CALFED proposes to support existing regulatory agencies generally in the following manner in determining and correcting toxicity associated with pesticide use:

Verify initial reports that a pesticide is causing toxicity
- Confirm toxicity
- Verify chemical analysis
- Evaluate TIEs

Establish use patterns

Implement Corrective Actions
- Establish water quality targets
- Develop Management Practices
- Support implementation of Management Practices
- Evaluate implementation of Management Practices
- Monitor water quality for achieving water quality targets
- Reevaluate corrective actions as necessary

Diazinon/Chlorpyrifos Case Study

As an example of how a general method could be applied and how CALFED should proceed on a current problem, the following is a summary of the envisioned process as applied to diazinon and chlorpyrifos.

Toxicity linked to diazinon and chlorpyrifos

Toxicity from diazinon and chlorpyrifos has been detected in surface water during the winter and early spring from applications on orchards, during the summer from irrigation return water and during both winter and summer in urban runoff samples. Each is discussed briefly below.

Orchards--Toxicity testing of the estuary began in the late 1980s. Numerous bioassay and chemical studies have measured the organophosphate insecticide, in surface water samples in the Central Valley during winter months at toxic concentration to sensitive invertebrates (Foe and Connor,1991; Foe and Sheipline, 1993; Ross 1992;1993; Foe, 1995; Domagalski, 1995; Kratzer, 1997). Concern has been expressed that contaminants other than Diazinon might also be present in winter storm runoff from the Central Valley and contribute to invertebrate bioassay mortality. Therefore toxicity identification evaluations (TIEs) were conducted on samples testing toxic in *Ceriodaphnia* bioassays from the Sacramento and San Joaquin Rivers (Larson *et al.*, 1996, 1997;Foe in prep). The results confirm that diazinon was the primary toxicant.

Irrigation Return Water--Chlorpyrifos toxicity was detected on nine occasions in surface water from four agriculturally dominated backsloughs in the Delta-Estuary (French Camp Slough, Duck Slough, Paradise Cut, and Ulatis Creek; Deanovic *et al.*, 1996; Deanovic *et al.*, 1998). In each instance the *Ceriodaphnia* bioassay results were accompanied by modified phase I and II TIEs and chemical analysis which implicated chlorpyrifos. On four additional occasions phase III TIEs were conducted (Ulatis Creek 21 March 1995, Paradise Cut 15 March 1995, Duck Slough 21 March 1995, and French Camp Slough 23 March 1995). These confirmed that chlorpyrifos was the primary chemical agent responsible for the toxicity in these samples. Analysis of the spatial patterns of toxicity suggest that the impairment was largely confined to backsloughs and was diluted away upon tidal dispersal into main channels. The precise agricultural crops from which the chemicals originated are not known because chlorpyrifos is a commonly applied agricultural insecticide during the irrigation season. However, the widespread nature of chlorpyrifos toxicity at least in March of 1995 coincided with applications on alfalfa and subsequent large rainstorms. Further monitoring is needed to conclusively identify all responsible agriculture practices.

Urban--*Ceriodaphnia* bioassay mortality has been reported in urban creeks of Sacramento and Stockton including Morrison Creek, Mosher Slough, 5 Mile Slough, Calaveras River, and Mormon Slough, all of which are within the legal boundary of the Delta. A TIE was conducted on samples from each site which implicated the pesticides diazinon and chlorpyrifos. Chemical analyses demonstrated that diazinon and occasionally chlorpyrifos was present at toxic concentrations. Similar invertebrate (*Ceriodaphnia*) bioassay results coupled with TIES and chemical analysis from the San Francisco Bay Area suggest that diazinon and chlorpyrifos may be a regional urban runoff problem (Katznelson and Mumley, 1997).

Extent of Impairment

Orchards--The highest concentrations of diazinon and longest exposures are typically in small water courses adjacent to high densities of orchards. However, after the large storms of 1990 and 1992 diazion was measured in the San Joaquin River at the entrance to the Delta at toxic concentrations to the *Ceriodaphia dubia* in U.S. EPA three species bioassays (Foe and Connor, 1991; Foe and Sheipline, 1993). Following up on these findings, the U.S. Geological Survey and Regional Board traced pulses of diazinon from both the Sacramento and San Joaquin Rivers across the Estuary in 1993 (Kuivila and Foe, 1995). Toxic concentrations to *Ceriodaphnia* were observed as far west in the Estuary as Chipps Island, some 60 miles downstream of the City of Sacramento.

Diazinon is present in urban dominated creeks around the City of Sacramento and Stockton after winter storms as will be discussed below. However, background concentrations of diazinon in urban storm runoff increase after application on orchards in January and February suggesting that urban use is not the sole source of the chemical at this time (Connor, 1996). Volatization following application is known to be a major diazinon dissipation pathway from orchards (Glotfelty *et al.*, 1990) and a number of dormant spray insecticides have previously been reported in rain and fog in the Central Valley (Glotfelty *et al.*, 1987). Therefore, composite rainfall samples were collected in South Stockton in 1995 which demonstrated that diazinon concentrations in rain varied from below detection to about 4,000 ng/l (ten times the acute *Ceriodaphnia* concentration). The rainfall study was continued through March and April of 1995

to coincide with application of chlorprifos on alfalfa for weevil control. Chlorpyrifos concentrations in composite rainfall samples increased, ranging from below detection to 650 ng/l (again 10 times the acute *Ceriodaphnia* concentration). However, unlike diazinon, no study was conducted to ascertain whether chlorpyrifos concentrations in street runoff increased suggesting that agricultural inputs might be a significant urban source.

Irrigation--A bioassay study was conducted in agriculturally dominated waterways in the San Joaquin Basin in 1991 and 92 to determine the extent of toxicity. Chlorpyrifos was detected on 190 occasions between March and June of both years, 43 times at toxic concentrations to *Ceriodaphnia* (Foe, 1995). Many of the crops grown in the San Joaquin Basin are also cultivated on Delta Tracts and Islands. Not known was whether these same agricultural practices might also contribute to instream toxicity in the Delta. Follow-up studies were conducted as part of the State Water Board Bay Protection Program. Chlorpyrifos was periodically identified at toxic concentrations in back sloughs (Deanovic et al 1996;1998) suggesting that the same impairments occur in the Delta as in the San Joaquin Basin.

Urban--Detailed information on urban sources are not available for the Central Valley. However, source information has been obtained for the Bay Area and the conclusions are thought to also apply in the Valley with the caveat that the Bay area does not receive significant amounts of diazinon in rainfall as appears to occur in the Central Valley (personal communication, Val Connor). Confirmatory studies are needed to verify that the Bay Area conclusions also apply in the Valley.

The primary source of diazinon and chlorpyrifos in Bay Area creeks is from urban storm water runoff. Sampling in urbanized areas in Alameda County indicated that residential areas were a significant source but runoff from commercial areas may also be important (Scanlin and Feng, 1997). It is not known what portion of the diazinon and chlorpyrifos found in creeks is attributable to use in accordance with label directions versus improper disposal or over application. However, a preliminary study of runoff from residential properties suggest that concentrations in some creeks may be attributable to improper use (Scanlin and Feng, 1997).

Novartis, the Registrant for diazinon, has completed a diazinon probabalistic risk assessment for the Central Valley (Novartis Crop Protection, 1997). Little data were available for the Delta. The risk assessment suggests that the greatest impacts are likely to occur in water courses adjacent to sources such as orchards. Lower concentrations are predicted in mainstem Rivers. The report predicts that the Sacramento and San Joaquin Rivers will experience acutely toxic conditions to the 10% of most sensitive species 0.4 and 11.6% of the time in February, the period of most intensive diazinon off site movement[1]. Novartis concludes that the risk of diazinon alone in the Sacramento-San Joaquin River basin is limited to the most sensitive invertebrates,

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[1] Unfortunately, many agricultural pesticides are applied in the Central Valley and measured in the Rivers. When the risk assessment is repeated with multiple chemicals, the mainstem San Joaquin River is predicted to experience acutely toxic conditions about 30% of the year to the 10% of most sensitive species. Obviously, diazinon is only one of a suite of chemicals in the River and it is ecologically unrealistic to evaluate the impact of each chemical alone.

primarily cladocerans. Furthermore, the report notes that cladocerans reproduce rapidly and their populations are therefore predicted to recover rapidly. Also, the report predicts that indirect effects on fish through reductions in their invertebrate prey are unlikely as the preferred food species are unaffected by the diazinon concentrations observed in the rivers. The study recommends though, that the population dynamics of susceptible invertebrate species in the basin be evaluated along with the feeding habits and nutritional requirements of common fish species.

Identification of diazinon and chlorpyrifos in agricultural storm and irrigation return water and in urban storm runoff has resulted in the Central Valley Regional Board listing the Sacramento and San Joaquin Rivers and the Delta Estuary as impaired in the 303(d) list. The listing commits the Regional Board to developing at Total Maximum Daily Load for each constitutent.

Predominant Uses of Diazinon and Chlorpyirifos

Orchards About a half a million pounds of diazinon are applied each January and February in the Central Valley on about half a million acres of stonefruit and almond orchards to control boring insects (Foe and Sheipline, 1993).

Irrigation One and a half million pounds of chlorpyrifos were used in the Central Valley on agriculture in 1990 (Foe and Sheipline,1993). Major uses in March are on alfalfa and sugarbeets for weevil and worm control and between April and September on walnuts and almonds for codling moth and twig borer control. Two minor uses are on apples and corn.

Urban About a million pounds of diazinon and chlorpyrifos active ingredients were used in landscape and structural pest control in California in 1994 for control of ants, fleas and spiders by professional pest control personnel (Scanlin and Cooper, 1997; Department of Pesticide Regulation, 1996). Homeowner purchases and application of these could be equally as high. About 20 thousand pounds of diazinon is applied to alfalfa each year.

Data Needed

No biological surveys have been undertaken to determine the ecological significance of toxic pulses of diazinon. No instream monitoring to assess the impact of diazinon pulses on local aquatic communities has occurred. The Novartis diazinon ecological risk assessment predicts that impacts to sensitive invertebrates will occur, but that population recovery should be rapid. No indirect food chain effects upon larval and juvenile fish are predicted as these animals were assumed to be capable of switching to an alternate food source.

Detailed ecological studies are needed to ascertain whether invertebrate populations levels decrease and how long it takes for recovery to occur. These studies should target those areas of the watershed where monitoring has indicated that the most severe impacts might occur. The studies should also consider the additive ecological effect of multiple pesticide exposures. Studies are also needed to verify that higher trophic levels are not impacted by decreased invertebrate production. This work should emphasize potential impacts to threatened and endangered fish species.

The Integration Panel for the CALFED Ecosystem Restoration effort has set aside 1.5 million dollars for follow up work to determine the ecological significance of the pesticide excursions.

Furthermore, the Integration Panel asked the Contaminant Effects IEP project work team to recommend follow up studies.

Corrective Actions
Proposed corrective actions should be consistent with existing regulations and management agreements. The general actions that are required to begin to resolve this water quality problem include (1) establishment of interim and long-term targets (quantitative response limits and water quality objectives, respectively), (2) development and demonstration of cost effective management practices that can be implemented to meet the targets, (3) completion of studies to determine potential ecological impacts, (4) Monitoring to more fully describe existing conditions and evaluate effectiveness of Management Practices implementation, and (5) establishment of mechanisms for assuring implementation of management practices. CALFED staff will monitor progress made in these efforts and will periodically issues a report of progress.

Water Quality Criteria - The California Department of Fish and Game has developed an interim diazinon and chlorpyrifos hazard assessment criteria to protect freshwater aquatic life (Menconi and Cox, 1994) using the standard U.S. EPA criteria development process (U.S. EPA, 1985). A final Hazard Assessment criteria was not recommended as several data gaps were identified in the toxicological literature. Studies should be undertaken to fill these gaps. Once completed the Department of Fish and Game should be requested to use the information and calculate a final diazinon Hazard Assessment criteria. CALFED has agreed to fund the remaining portion of the study to establish a technically justified numerical goal. CALFED should fund work at both DPR and the State Board to convert the hazard assessment criteria into quantitative response limits and water quality objectives.

Agricultural Management Practices Development - Development of Agricultural Management Practices (MPs) to keep orchard dormant spray insecticides on farm and out of surface water is just beginning. The work of the Department of Pesticide Regulation, U.C. Integrated Pest Management, the Registrants, and others have been described in the appendix - *Summary of Actions*. The work of each group is too preliminary at present to ascertain whether any of these might be successfully implemented to reduce diazinon and chlorpyrifos concentrations in surface waters to non-toxic levels. No work has yet begun on evaluating possible irrigation return pesticide control actions. Once preferred MP options are identified, funding should be sought for their field evaluation. At a minimum, the field testing should ascertain the amount of pesticide reduction achieved under varying Central Valley orchard conditions, whether the reductions would meet water quality objectives, and the cost per acre to the farmer to implement the practice. CALFED is presently funding researchers at UC Davis to investigate alternatives to traditional uses of organophosphate insecticides in agricultural pest management systems, which will contribute to Agricultural MP development.

Future costs of MP development should be shared with other Agencies to help maintain cost effectiveness to realize mutual and multiple benefits associated with widespread implementation of appropriate management practices. CALFED should evaluate feasibility of supporting pollutant tradeoff programs.

Urban Management Practice Development- Finding diazinon and chlorpyrifos in urban runoff

prompted the formation of an Urban Pesticide Committee (UPC). The UPC is an *ad hoc* committee formed to address the issue of toxicity in urban runoff and wastewater treatment plant effluent due to organophosphate insecticides, in particular diazinon and chlorpyrifos. The UPC is composed of staff from the U.S. EPA, the San Francisco Bay and Central Valley Regional Water Quality Control Boards, the Department of Pesticide Regulation, Novartis and Dow Elanco, municipal storm water programs, the Bay Area Stormwater Management Agencies Association, County Agricultural Commissioners, Wastewater treatment plants, the University of California, and Consultants. The members of the UPC are committed to working in partnership with the various stakeholders to develop effective measures to reduce the concentrations of organophosphate insecticides in urban runoff and wastewater treatment plant effluent.

CALFED has funded several projects to begin development of MPs to reduce offsite movement of pesticides in the urban arena.

Evaluate Implementation of MPs - The pesticide effort is still at the early stages of MP development. However, once MPs are developed, then the CALFED should begin discussions with both the regulatory and regulated community about the most efficient methods of implementing the urban and agricultural MPs. CALFED should consult with DPR and the UPC with results of MP Implementation Evaluation to determine whether additional MP efforts are needed.

Monitoring - CALFED can join the monitoring efforts of DPR and the Regional Water Board to monitor surface water in the Sacramento and San Joaquin river watersheds to help determine compliance with applicable water quality objectives and establish the data base useful in developing TMDLs and other regulatory tools necessary to achieve compliance. This monitoring portion, as well as some studies, may be incorporated in the Comprehensive Monitoring and Research Program (CMARP) through CALFED.

Appendix

Summary of Actions

The Department of Pesticide Regulation (DPR) and the State Water Resources Control Board (SWRCB) both have statutory responsibilities for protecting water quality from adverse effects of pesticides. In 1997, DPR and the SWRCB signed a management agency agreement (MAA), clarifying these responsibilities. In a companion document, the Pesticide Management Plan for Water Quality (Pesticide Management Plan), a process was outlined for protecting beneficial uses of surface water from the potential adverse effects of pesticides. The process relies on a four-stage approach: Stage 1 relies on education and outreach efforts to communicative pollution prevention strategies. Stage 2 efforts involve self-regulating or cooperative efforts to identify and implement the most appropriate site-specific reduced-risk practices. In stage 3, mandatory compliance is achieved through restricted use pesticide permit requirements, implementation of regulations, or other DPR regulatory authority. In stage 4, compliance is achieved through the SWRCB and RWQCB water quality control plans or other appropriate regulatory measures consistent with applicable authorities.

Currently, DPR is coordinating a stage 2 effort to address effects of dormant sprays on surface water. DPR's stated goal is to eliminate toxicity associated with dormant spray insecticides (i.e., chlorpyrifos, diazinon, and methidathion) in the Sacramento and San Joaquin River Basins and Delta. CALFED is granting funds to the university of California, Davis for the development of BMPs for various uses of pesticides. As long as progress continues toward compliance with appropriate water quality objectives, stage 3 activities will be unnecessary.

The U.S. EPA requires Regional Boards maintain 303(d) lists of impaired water bodies. The Sacramento and San Joaquin Rivers and Delta are on the Regional Boards 303(d) list because of elevated concentrations of diazinon. The list requires the Regional Board to adopt a schedule for setting Total Maximum Daily Load (TMDLs). In January of 1998 staff will request that the Central Valley Board approve a TMDL schedule for diazinon for the Sacramento and San Joaquin Rivers and the Delta. Components of a TMDL include problem description, numeric targets, monitoring and source analysis, implementation plan, load allocations, performance measures and feedback, margin of safety and seasonal variation and public participation. It should be noted that if monitoring demonstrates that the waterways are in compliance with the numeric target then no further action is required.

Several activities are underway in the Basin to develop agricultural BMPs to control orchard dormant spray runoff. These are summarized below by the Agency conducting the study.

Department of Pesticide Regulation In addition to the activities already discussed, DPR is investigating orchard floor management as a means to reduce discharges of dormant sprays into surface waterways (Ross et al., 1997). At an experimental plot at UCD, DPR staff measured discharges of chlorpyrifos, diazinon, and methidathion from a peach orchard with three orchard floor treatments. Investigations are continuing in a commercial orchard. At California State University at Fresno, DPR is investigating the effects of microbial augmentation and postapplication tillage on runoff of dormant sprays. Results will be highlighted in DPR's own outreach activities and will be made available to other groups interested in the identification and promotion of reduced-risk management practices.

DPR is also monitoring water quality at four sites--two each within the Sacramento and San Joaquin river watersheds. During the dormant spray use season, approximately January through mid-March, water samples will be collected five times each week from each site. Chemical analyses are performed on each sample; one chronic and two acute toxicity tests, using Ceriodaphnia dubia, are performed each week.

Novartis The Registrant of diazinon distributed over ten thousand brochures last winter through U.C. Extension, County Agricultural Commissioner's Offices, and Pesticide distributors. The brochure described the water quality problems associated with dormant spray insecticides and recommended a voluntary set of BMPs to help protect surface waters. Novartis intends to repeat the education and outreach program this winter.

DowElanco and Novartis The Registrants of chlorpyrifos and diazinon have undertaken a multiyear study in Orestimba Creek in the San Joaquin Basin with the primary objective of identifying specific agricultural use patterns and practices which contribute the bulk of the off-site chemical movement into surface water. The study involves an evaluation of pesticide movement in both winter storms and in summer irrigation return flows. Objectives in subsequent years are to use the data to develop and field test BMPs to reduce off site chemical movement. The first year of work is complete and a report may be released soon.

Biologically Integrated Prune Systems (BIPS) The BIPS program is a community-based project that supports implementation of reduced-risk pest management strategies in prune orchards. The reduction or elimination of organophosphate dormant sprays is a goal. The project has a strong outreach component that includes demonstration sites and "hand-on" training for growers and pest control advisors (PCAs). BIPS is a recipient of one of DPR's pest management grants.

Biologically Integrated Orchard Systems (BIOS) The BIOS program pioneered community-based efforts to

implement economically viable, nonconventional, pest management practices. It emphasizes management of almond orchards in Merced and Stanislaus counties in ways that minimize or eliminate the use of dormant spray insecticides. BIOS was a recipient of a DPR pest management grant and a federal Clean Water Act (CWA) section 319(h) nonpoint source implementation grant. BIOS also received funding from CALFED.

Biorational Cling Peach Orchard Systems (BCPOS) This project has the same goals as the BIPS program, except that it focuses on primary pests in cling peach orchards. The University of California Cooperative Extension is acting as project leader, with Sacramento and San Joaquin valley coordinators. BCPOS is another recipient of a DPR pest management grant.

Colusa County Resource Conservation District The Colusa County Resource Conservation District (RCD) is leading a runoff management project within the watershed of Hahn Creek. Project participants are trying to identify management practices that reduce runoff from almond orchards within the watershed, thereby reducing pesticide loads in the creek. Outreach and demonstration sites are part of this project. This project was the recipient of a CWA section 319(h) grant.

Glenn County Department of Agriculture The Glenn County Department of Agriculture is organizing local growers and PCAs to address the use of dormant spray insecticides in the county. The local RCD is also involved; they are applying for grants to facilitate the implementation of reduced-risk pest management practices.

Natural Resources Conservation Service-Colusa Office The Colusa County office of the Natural Resources Conservation Service (NRCS) was recently awarded over $100,000 from the Environmental Quality Incentives Program (EQIP), one of the conservation programs administered by the U.S. Department of Agriculture. EQIP offers contracts that provide incentive payments and cost sharing for conservation practices needed at each site. Most of these funds should be available to help implement reduced-risk pest management practices in almond orchards in the area.

Natural Resources Conservation ServiceBStanislaus Office The Stanislaus County office of NRCS was recently awarded $700,000 from EQIP. Half of the funds are allocated to address livestock production practices, but most of the remaining funds should be available to address dormant sprays and the implementation of reduced-risk pest management practices. Local work groups, comprised of RCDs, NRCS, the Farm Services Agency, county agricultural commissioners, Farm Bureau, and others will determine how EQIP funds will be distributed. Applicants for EQIP funds will be evaluated on their ability to provide the most environmental benefits.

Nature Conservancy The Nature Conservancy is enrolling more prune growers in the BIPS project as it proceeds with its Phelan Island restoration project in the Sacramento Valley. This project is supported by a CWA section 319(h) grant.

U.C. Statewide Integrated Pest Management Project In late 1997 the U.C. Statewide Integrated Pest Management Project was awarded a two year grant by the State Water Resource Control Board to: (1) identify alternate orchard management practices to prevent or reduce off site movement of dormant sprays, (2) provide outreach and education on these new practices to the agricultural community, and (3) design and initiate a monitoring program to assess the success of the new practices. A Steering Committee composed of representatives from Commodity groups, State Agencies including Regional Water Board staff, and U.C. Academics was formed to serve as a peer review body for the study. UCIPM received CALFED funding.

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